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OBSTETRICS AND GYNAECOLOGY

KILPAUK MEDICAL COLLEGE

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

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APRIL 2014

BONAFIDE CERTIFICATE

This is to certify that the Dissertation entitled **"PREVALENCE OF METABOLIC SYNDROME AMONG PATIENTS WITH POLYCYSTIC OVARIAN SYNDROME"** is the bonafide original work of Dr. S.S. Meera, postgraduate, Department of Obstetrics and Gynaecology KMCH, Chennai 10 in partial fulfilment of the requirements of the Tamil Nadu Dr. M.G.R. Medical University for award of MS degree Branch II (Obstetrics & Gynaecology) to be held in April 2014 . The period of postgraduate study and training was from May 2011 to April 2014.

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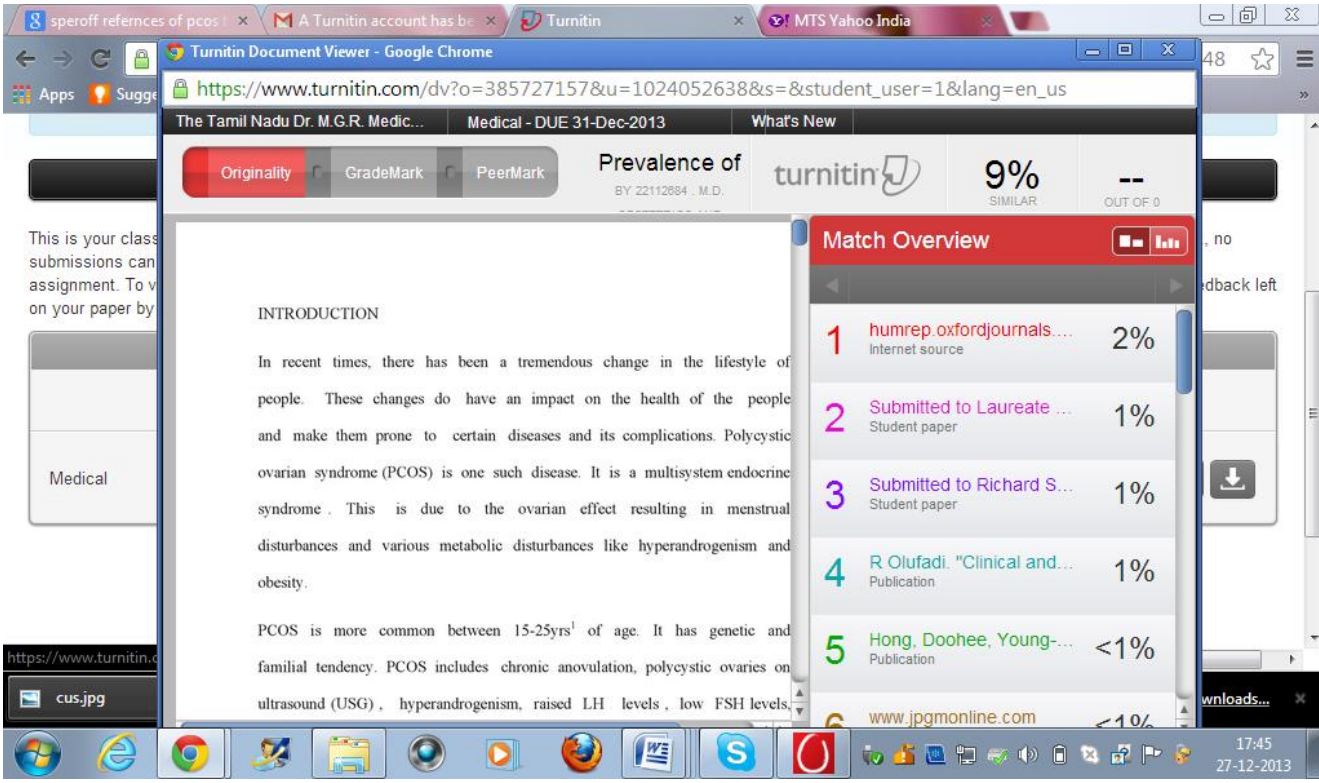
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INTRODUCTION
In recent times, there has been a tremendous change in the lifestyle of people. These changes do have an impact on the health of the people and make them prone to certain diseases and its complications. Polycystic ovarian syndrome (PCOS) is one such disease. It is a multisystem endocrine syndrome . This is due to the ovarian effect resulting in menstrual disturbances and various metabolic disturbances like hyperandrogenism and obesity.
PCOS is more common between 15-25yrs[1] of age. It has genetic and familial tendency. PCOS includes chronic anovulation, polycystic ovaries on ultrasound (USG) , hyperandrogenism, raised LH levels , low FSH levels.
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CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A descriptive study of prevalence of metabolic syndrome in patients with polycystic ovarian syndrome" – For Project Work submitted by Dr.S.S.Meera, MS (O&G), PG Student, KMC, Chennai-10.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE
09 OCT 2013
Kilpauk, Chennai-10.

7/10/13

CHAIRMAN,
Ethical Committee
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LIST OF ABBREVIATIONS

1.	PCOS	-	Polycystic Ovarian Syndrome
2.	USG	-	Ultra Sonogram
3.	LH	-	Leutenizing Hormone
4.	FSH	-	Follicle Stimulating Hormone
5.	GnRH	-	Gonadotropin Releasing Hormone
6.	SHBG	-	Serum Hormone Binding Globulin
7.	ESHRE	-	European Society for Human Reproduction and Embryology
8.	AEPCOS	-	Androgen Excess Polycystic Ovarian Syndrome
9.	NICHD	-	National Institute Of Child Health and Human Development
10.	DHEA – S	-	Dehydroepiandrosterone sulfate

INTRODUCTION

In recent times, there has been a tremendous change in the lifestyle of people. These changes do have an impact on the health of the people and make them prone to certain diseases and its complications. Polycystic ovarian syndrome (PCOS) is one such disease. It is a multisystem endocrine syndrome . This is due to the ovarian effect resulting in menstrual disturbances and various metabolic disturbances like hyperandrogenism and obesity.

PCOS is more common between 15-25yrs[1] of age. It has genetic and familial tendency. PCOS includes chronic anovulation, polycystic ovaries on ultrasound (USG) , hyperandrogenism, raised LH levels , low FSH levels, elevated fasting insulin, low serum binding hormone globulin. PCOS may be autosomal dominant inherited. Prevalence of PCOS in reproductive age group is 5-10%[2].

Polycystic ovarian syndrome is associated with metabolic disturbances. Insulin resistance, obesity all contribute for the metabolic disturbances. They have high chances of metabolic syndrome characterized by hypertension, increased fasting glucose, dyslipidemia and increased waist circumference.

Metabolic syndrome is prevalent in women with PCOS and it is on the rise due to alterations in the lifestyle . Therefore it is necessary for PCOS women to be screened for metabolic syndrome to prevent long term complications like cardiovascular disease , type 2 diabetes mellitus and endometrial cancer.

AIM OF THE STUDY

To study the prevalence of metabolic syndrome among patients with PCOS attending Gynaecology outpatient department, OBG Department, KMCH using clinical features and biochemical tests during the period May 2013 to November 2013.

REVIEW OF LITERATURE

Polycystic ovaries were recognized from mid 18th century. They were known as multicystic ovaries or sclerotic ovaries. In the early 20th century, polycystic ovaries were considered as a result of inflammation due to infection and congestion.

Michael L. Leventhal and Irving F. Stein together described a syndrome associated with anovulation[28] in 1935. They described that patients with PCOS had hirsuitism and amenorrhea. They proposed the theory that the thickened ovarian capsule prevented the follicles from reaching and escaping the surface of the ovary .

The characteristic polycystic ovaries results when chronic anovulation is present for a long period of time. About 75% of anovulatory women will have polycystic ovaries.The histologic picture of Stein- Leventhal ovary [30] is as follows

- Cross sectional area is twice as normal ovaries.
- Sub -cortical stroma is 5% thicker.
- Developing and atretic follicles are double in number.
- Tunica is 50% thicker and has more collagen.
- Hilar cell nests are four fold greater in number.

PATHOPHYSIOLOGY

PCOS is a complex multisystem disorder, where numerous genetic and environmental factors contribute to its pathophysiology. Polycystic ovaries and clinical features of PCOS are due to disturbances in the development of follicle causing anovulation.

Gonadotropin Secretion And Action:

PCOS women have increased serum Leutenising Hormone(LH), low Follicle Stimulating Hormone (FSH) levels, and raised LH: FSH ratios. Both increased pulse frequency and amplitude of LH contributes for raised LH levels. The pulse frequency of LH is not as constant as seen in normal ovulatory women , which is one pulse per hour. The bioactivity[25] of LH in PCOS women is also more. The response of LH to exogeneously given GnRH is also raised in women with PCOS.

FSH levels are decreased. The decrease is due to increase in pulse frequency of GnRH. Negative feedback of estrones and increased levels of Inhibin-B also contribute to the decrease in FSH.

Thus excessive LH[32] secretion is an important cause of disrupted development of follicle resulting in anovulatory cycles.

INSULIN RESISTANCE

The association between hyperandrogenism and glucose intolerance was first described in 1921 by Theirs and Archard[8] . They reported a diabetic women with beard . Insulin resistance is a feature of variety of conditions like type 2 diabetes, obesity, pregnancy, stress, and PCOS. The role of insulin in the pathogenesis of polycystic ovarian syndrome was first suggested in 1980 . In that study significant correlation was demonstrated between testosterone and basal levels of insulin. They also demonstrated correlation after an oral glucose load between testosterone and insulin levels

Insulin resistance is said to be present when the actions of either endogeneous or exogeneously given insulin are not effective on fat, muscle and adipose tissue. In adipose tissue due to insulin resistance there is hydrolysis of Triglycerides and increased free fatty acids . In muscle there is decreased glucose

utilization and increased hepatic gluconeogenesis causing elevated blood glucose and compensatory hyperinsulinemia.

High circulating insulin levels cause hyperandrogenism in PCOS women by two mechanisms . Insulin acts on theca cells of ovarian stroma through insulin receptors and stimulates the production of androgens from ovaries. It inhibits hepatic Serum Hormone Binding Globulin (SHBG) production.

Actions of insulin are mediated through its receptors [26] by two intracellular pathways. Metabolic effects are mediated through phosphatidyl inositol 3-kinase pathway. Proliferative action is mediated through mitogen – activated protein kinase pathway. In women with PCOS activation of mitogen pathway by insulin is increased . there is also resistance in the metabolic pathway of insulin mediated by phosphatidyl-inositol 3-kinase.

" Thus insulin actions can be selectively inhibited and enhanced at the same time via different signaling pathways" . This explains the mechanism by which insulin stimulate hyperandrogenism in women, who are insulin resistant.

Insulin and androgens together lower SHBG causing free androgen levels which in turn aggravates insulin resistance. Thus insulin resistance and hyperinsulinemia are the cause of hyperandrogenism.

Insulin and hyperinsulinemia are important factors in the pathophysiology of PCOS. 20-50%[8] of PCOS women have no insulin resistance and prevalence of PCOS is low among women who have insulin resistance. After ovarian wedge resection sensitivity of insulin is not changed. Though insulin resistance and hyperinsulinemia contribute major portion in the pathophysiology of PCOS they are not the primary cause in all PCOS women.

HYPERANDROGENISM

Hyperandrogenism is important feature of PCOS . Excess androgen is produced both from the ovaries and adrenals with major contribution from the ovaries. Sixty percent of circulating androstenedione is produced from the ovaries and the rest from the adrenls . Sixty percent of testosterone is also produced from the

ovaries and the rest of the testosterone are produced from peripheral conversion of androstenedione.[21]

Important reason for excess production of androgen from ovaries in PCOS women is due to increased LH secretion , increased bioactivity of LH, hyperinsulinemia and obesity. Other factors include increased volume of theca cells due to increased ovarian stroma, increased sensitivity to LH and overexpression of LH receptors.

High local androgens are responsible for the characteristic polycystic ovaries. Androgens are converted to more potent androgen by 5 alpha reductase. This potent androgen cannot be further converted to estrogen. These androgens further inhibit the aromatase activity and FSH stimulated induction of LH receptors on the granulosa cells. Thus granulosa cells of PCOS patients are not able to produce adequate amount of estrogen , necessary for follicular development causing arrest of the growth before full maturation.

New follicles continue to grow and get arrested before full maturation which results in multiple small follicular cysts. These follicular cysts are surrounded by hyperplastic theca cells. Increased ovarian stroma is contributed by the atretic follicles.

Adrenal androgens like androstenedione , DHEA , DHEA-S are also increased in PCOS patients . Even when the synthesis of androgens by ovaries were inhibited by GnRH agonists, adrenal androgens remained higher in PCOS women when compared with normal women. Adrenal androgens donot have any intrinsic activity. There is peripheral conversion of adrenal androgens to testosterone. This peripheral conversion contributes to the pathophysiology of polycystic ovarian syndrome.

The role of high amount of local androgen levels in the pathophysiology of Polycystic ovarian syndrome is demonstrated by wedge resection of ovaries.[30] Wedge resection of ovaries resulted in decrease in production of androgens by ovaries. This decrease was followed by the return of normal menstrual cycles . It can be concluded that high amount of androgens inhibit development of follicle and also inhibit ovulation.

DIAGNOSIS OF PCOS

Polycystic ovarian syndrome is not a specific disease. It is a syndrome characterized by group of signs and symptoms. Clear cut definition of PCOS is important because of the complications associated with PCOS. Women with PCOS are at increased risk of getting , cardiovascular disease obesity , endometrial cancer, dyslipidemia, diabetes mellitus, hypertension. It is also important to diagnose PCOS because of its health implications in other family members and also due to the need of life long treatment

In earlier times the disease was described based on hirsuitism , menstrual disturbances and enlarged ovaries. Only in recent times the role of insulin resistance in the pathopysiology of PCOS have been recognized. The attention is now being focused on the metabolic consequences of the disease.[15]

CRITERIA FOR PCOS

There are three different and distinct criterias to define PCOS till date. The main advantage of having specific criteria for PCOS is for research purposes . The three criterias are National

Institute of Child Health and Human Development , Androgen excess and PCOS society criteria and American Society for Human Reproduction (ASRM) held in Rotterdam, the Netherlands.

The first to define PCOS was National Institue Of Child Health and Human Development(NICHD) in 1990.

1) Hyperandrogenism
2) Menstrual dysfunction
3) Exclusion of other disorders with same clinical symptoms

The second was defined in a conference in 2003 conducted by the European Society for Human Reproduction and Embryology (ESHRE) and American Society for Reproductive Medicine (ASRM) in Rotterdam[28], The Netherlands . It concluded that atleast two of the three major criteria should be present.

1) Oligomenorrhoea
2) Clinical or biochemical hyperandrogenism
3) Polycystic ovaries (USG) , excluding other androgen excess disorders

The third was defined by Androgen Excess and Polycystic ovarian syndrome Society (AE-PCOS) in 2006.

1) Hyperandrogenism
2) Oligomenorrhoea or anovulation and or polycystic ovaries
3) Exclusion of other androgen excess disorders.

All these criterias were designed only to refine the diagnosis of PCOS,and for purpose of research. NICHD criteria says that both hyperandrogenism and menstrual dysfunction are necessary for diagnosis of PCOS.

The Rotterdam criteria 2003 says that polycystic ovaries, are evidence of ovulatory dysfunction and should be included in the criteria. It also highlights that hirsuitism and menstrual abnormalities can be either present or absent. "AE-PCOS 2006" criteria says that polycystic ovaries can be included but still hyperandrogenism must be present for any patient to be categorized as PCOS.

The use of different criterias to define PCOS creates confusion among patiens and clinicians. "National Institute of Health

Evidence-based Methodology Workshop on PCOS in December 2012 concluded that the Rotterdam criteria should be adopted for now because it is the most inclusive" [27]

FEATURES OF PCOS

Hyperandrogenism

Hyperandrogenism can be either clinical or biochemical. Hirsuitism , acne and androgenic alopecia contribute to clinical hyperandrogenism . All these features are due to the effect of androgens on the pilosebaceous unit. Clinical and biochemical hyperandrogenism are poorly related as the pilosebaceous unit's sensitivity is not same among all individuals.

Clinical Hyperandrogenism :

Clinical hyperandrogenism is characterized by hirsuitism, acne , virilization , temporal balding and decreased muscle mass.

HIRSUITISM

It is defined as excessive growth of hair on face and body in male pattern in women. It is necessary to understand the embryology of hair and hair growth. It is from the follicle the

hair grows. Hair follicle, sebaceous gland, and arrector pili muscle together constitute the pilosebaceous unit. This pilosebaceous unit is sensitive to hormones , especially the more potent androgen , Dihydrotestosterone(DHT). 5 alpha - reductase converts testosterone to dihydrotestosterone . It is DHT which is responsible for stimulation of hair follicles, so local levels of 5 alpha – reductase also influence the stimulation of hair follicle.

Human hair is of two types. Vellus and terminal hair. Vellus is fine, soft, and short . It is not pigmented . It is usually present over face, back and chest. Terminal hair is dark, coarse and long. It is pigmented and is present over the scalp, pubis and axilla. Excess growth of the terminal hair on face, and body in women is called hirsuitism. It is due to the excess amount of androgen.

Sexual hair responds to sex hormones. It grows primarily on the chest, pubis, axilla and lower abdomen. Androgens stimulate growth of hair follicles making it thick, dark and long in areas sensitive to androgen. Testosterone increases the pigmentation and diameter of hair. The amount of time spent by terminal hair in the phase of anagen is increased by androgens in all areas excepet scalp

The most common cause of excessive androgens in women is PCOS. Hirsuitism is graded by modified Ferriman –Gallwey score . 9 androgen sensitive areas are selected and a score of 1-4 is given according to the extent of hirsuitism. A score of 6-8[31] defines hirsuitism.

The growth of hair is not continuous. It is cyclic. It undergoes three phases. The resting phase is called quiescent phase, growth phase is called as anagen and the phase of involution is called as catagen. In the anagen phase hair is short and loose. Only in the anagen phase hair grows to its maximum. Androgens decreases the time spent by hair in anagen phase in scalp whereas it increases the amount of time spent by hair in anagen phase in all other places like forearm and face.

Nine androgen sensitive areas are upper lip, chin, inter mammary area, lower abdomen, midline from umbilicus to pubic symphysis, forearm, back of thigh, interscapular region and gluteal region.

In hirsuitism women, 60% of testosterone and androstenedione are derived from the ovary . The rest is

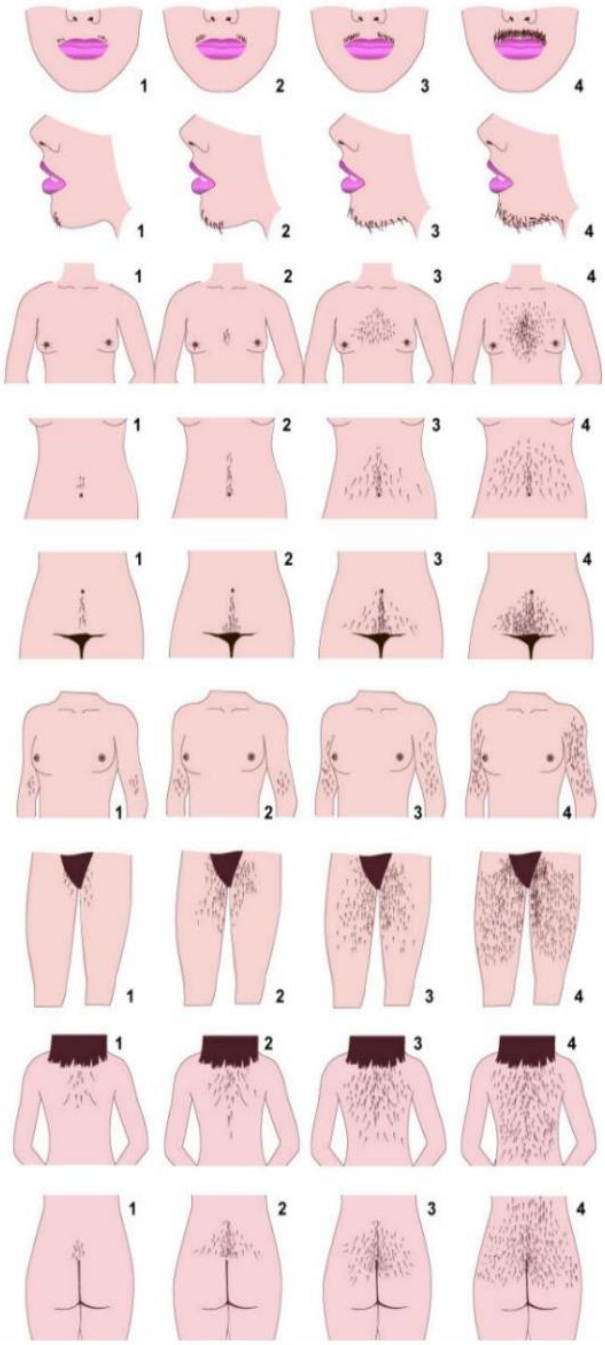
contributed by the testosterone which is produced from peripheral conversion. The marker for peripheral metaboliasm of androgen is 3 alpha androstanediol glucuronide. This 3 alpha androstanediol correlates wellwith 5 alpha reductase activity. In women with hirsuitsm with normal androgen levels, 5alpha reductase is increased.

Androgen excess disorders and chronic anovulation are the most common cause of hirsuitism. Adrenal causes are uncommon.

MODIFIED FERRIMAN –GALLWEY SCORE

A score of 1-4 is given. Scores between 6-8 is considered hirsuitism.

Figure 1



Other causes of hirsuitism include

- Classical congenital adrenal hyperplasia
- Non classical congenital adrenal hyperplasia
- Cushing syndrome
- HAIR –AN syndrome [12] (Hyperandrogenism, insulin resistance, and Acanthosis nigricans)
- Androgen secreting neoplasm
- Idiopathic hirsuitism
- Hyperprolactinemia
- Pregnancy luteoma
- Drugs like Phenytoin, Minoxidil and Diazoxide.

Acne , alopecia, temporal balding, and seborrhea are other clinical signs of androgen excess. Virilization is present if there is severe amount of excess androgen. Virilization signs include deepening of voice, breast atrophy, increased muscle mass, and clitoromegaly.

The other physical signs of hyperandrogenism includes galactorrhoea, which is suggestive of hyperprolactinemia and abdominopelvic masses suggestive of androgen secreting tumors.

Figure 2

Hirsutism

Excessive overgrowth of terminal hair is called hirsuitism.

Modified ferriman gallway score is used to define hirsuitism.

The physical signs of hyperandrogenism reflect the severity of androgen excess. All women with hirsuitism do have an increased production of androgens, both testosterone and androstendione

BIOCHEMICAL HYPERANDROGENISM

Dehydroepiandrosterone sulfate (DHEA-S), Testosterone, Dehydroepiandrosterone sulfate (DHEA), Dihydrotestosterone(DHT) and Androstenedione are the major circulating androgens in women. Circulating androgen levels and the sensitivity of hair follicles to the circulating androgens cause hirsuitism.

DHEA-S is produced exclusively by adrenal glands . DHEA is produced by both ovaries and adrenals . DHEA is also produced from the peripheral conversion of DHEA-S.

Androstenedione is produced equally by ovaries and adrenals. DHEA-S, DHEA and Androstenedione have to be converted to testosterone for them to exert their androgenic actions.

Testosterone is secreted by both adrenals and ovaries. Peripheral conversion of androstenedione also contribute to

production of testosterone. It is the free testosterone which is responsible for the androgenic actions. 80% of testosterone is bound to SHBG , 19% to albumin and only 1% is free. Any condition altering the amount of SHBG will affect the amount of free testosterone. Most of the serum immunoassays measure both the free and bound testosterone. Serum total concentration of testosterone doesnot reflect the amount of androgen excess as testosterone is converted to DHT which is more potent androgen and has a longer of duration than testosterone .

DHEA-S is the marker for adrenal androgens. It remains stable through out day and night. Though DHEA-S can be taken as marker of hyperandrogenism in patients with PCOS the sensitivity and specificity is very less for it to be considered as the diagnostic marker of hyperandrogenism.

Thus for clinical purposes hyperandrogenism can be identified by hirsuitism itself rather than measuring the amount of androgens[21].

OVULATORY DYSFUNCTION

Most of the women with PCOS have menstrual disturbances. About 80%[10] of them have ovulatory dysfunction. The most common abnormalities are oligoamenorrhoea and amenorrhoea. The normal inter -menstrual period is 21- 35 days.

Oligomenorrhoea is defined as absence of menses for a period of 35-182 days. Amenorrhoea is defined as absence of menses for a period of more than 182 days.

Very few women have polymenorrhoea. Polymenorrhoea is regular cycles occurring less than 25 days. Only 2%[8] of PCOS women have polymenorrhoea. About 15%[8] of women with polycystic ovarian syndrome have normal menstrual cycles. Other common conditions with anovulatory state are hyperthyroidism, hypothyroidism, hyperprolactinemia.

Oligomenorrhoea and amenorrhoea are due to chronic anovulation. Chronic anovulation is due to increased LH , low FSH, high amount of local androgens , increased inhibin levels. All these together prevent the formation of follicle. It is followed by atresia of follicles leading to a chronic anovulatory state

POLYCYSTIC OVARIES :

- Polycystic ovaries appear macroscopically as enlarged and lobulated and have a very thick capsule with no adhesions.
- On USG they appear as multiple follicles ,usually more than or equal to 12 measuring about 2-9mm in diameter.
- They are located along the border giving them a necklace pattern
- ovarian volume is increased > 7 ml.
- Atretic follicles are also visible .
- Stromal hyperplasia , thecal hyperplasia and atretic follicles contribute to the increased ovarian volume[5].

Rotterdam criteria takes into consideration only the number of follicles whereas the others define PCOS by considering both number of follicles and also the ovarian volume .

Polycystic ovaries may also be present in women using oral Contraceptives. It is also present in normal women who have normal menstrual cycles.

Although polycystic ovaries are present in most women with PCOS, the important point to be noted is, polycystic ovaries are not necessary for the diagnosis of PCOS.

POLYCYSTIC OVARIES ON USG

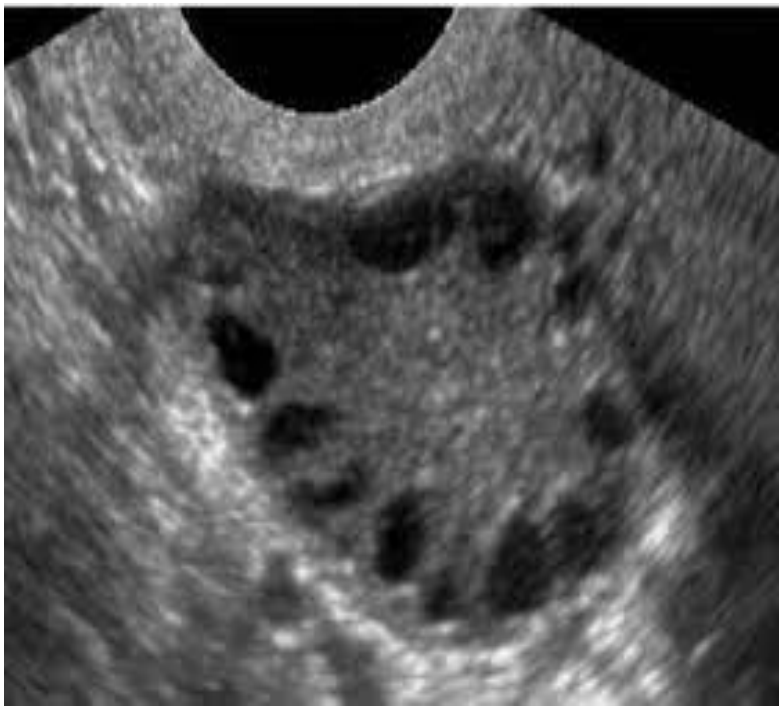
Twelve or more follicles .

Each follicle 2-9mm in diameter.

Ovaraian volume >10cm^3

Arranged peripherally

Figure 3



POLYCYSTIC OVARIES(USG)

OTHER FEATURES OF PCOS

Insulin Resistance:

Most of women with PCOS have insulin resistance. When compared with lean women insulin resistance is more in obese women . Insulin resistance can be demonstrated by the serum fasting insulin levels. Levels more than 30microunits/ml are suggestive of insulin resistance. Insulin sensitivity can be identified by fasting glucose/insulin ratio. Sensitivity is reasonable if the ratio is less than 4.5 .[12]

Another method to assess the insulin sensitivity is by Homeostatic model assessment of insulin resistance (HOMA-IR) .

Product of fasting insulin and fasting glucose divided by constant 22.5 gives HOMA-IR. Normal values are 3-3.9. Values greater than this indicate insulin resistance.

Insulin resistance can also be assessed by QUICKI[20] , quantitative insulin sensitivity check index.

Inverse of logarithmic sum of glucose and insulin gives the value of QUICKI. Normal value is 0.33. OGTT oral glucose

tolerance test is used to diagnose glucose tolerance and diabetes mellitus.

OBESITY

Obesity is an important feature of PCOS. 70%[8] of PCOSwomen are obese and the remaining are lean. Menstrual dysfunction, infertility and hirsuitism are higher in obese PCOS women when compared with lean PCOS women.

Obesity itself is related to insulin resistance. Intraabdominal obesity is highly correlated with insulin resistance . Visceral fat is metabolically more active than subcutaneous fat .Visceral fat is sensitive to lipolysis and releases large amount of fatty acids. These fatty acids produce large amount of cytokines like leptin, interleukin -6, and tumor necrosis factor alpha. All these cytokines are involved in insulin resistance.

Stein Leventhal initially noted the association of obesity with the combination of anovulation, polycystic ovaries and hirsuitism.

OVARIAN EFFECTS OF OBESITY

Obesity is related to insulin resistance . Insulin stimulates production of androgens from ovaries . Multiple growth factors like insulin growth factor are more in obese women. These growth factors stimulate the production of androgens. They also inhibit aromatization of androgens to estrogens

Hypothalamic pituitary Action

Insulin resistance is associated with the effects of hypothalamus. Adipokines like leptin play very important role in regulating the function of ovary. This can be demonstrated in patients with anorexia nervosa . secretion of gonadotropin is suppressed in them . Gonadotropin suppression causes loss of ovulatory function.

Metabolic effects:

Obesity is related with increased risk of metabolic disturbances. Obesity is related to insulin resistance. Influence of both PCOS and obesity on insulin resistance is independent as

well as have additive effects. Dyslipidemia is common in obese women who have PCOS than lean PCOS women.

Reproductive effects:

Obesity as such doesnot have any effect on the reproductive functions, except for causing anovulation and hirsuitism. Obesity and PCOS are associated with endometrial cancer. Obesity is associated with breast cancer.

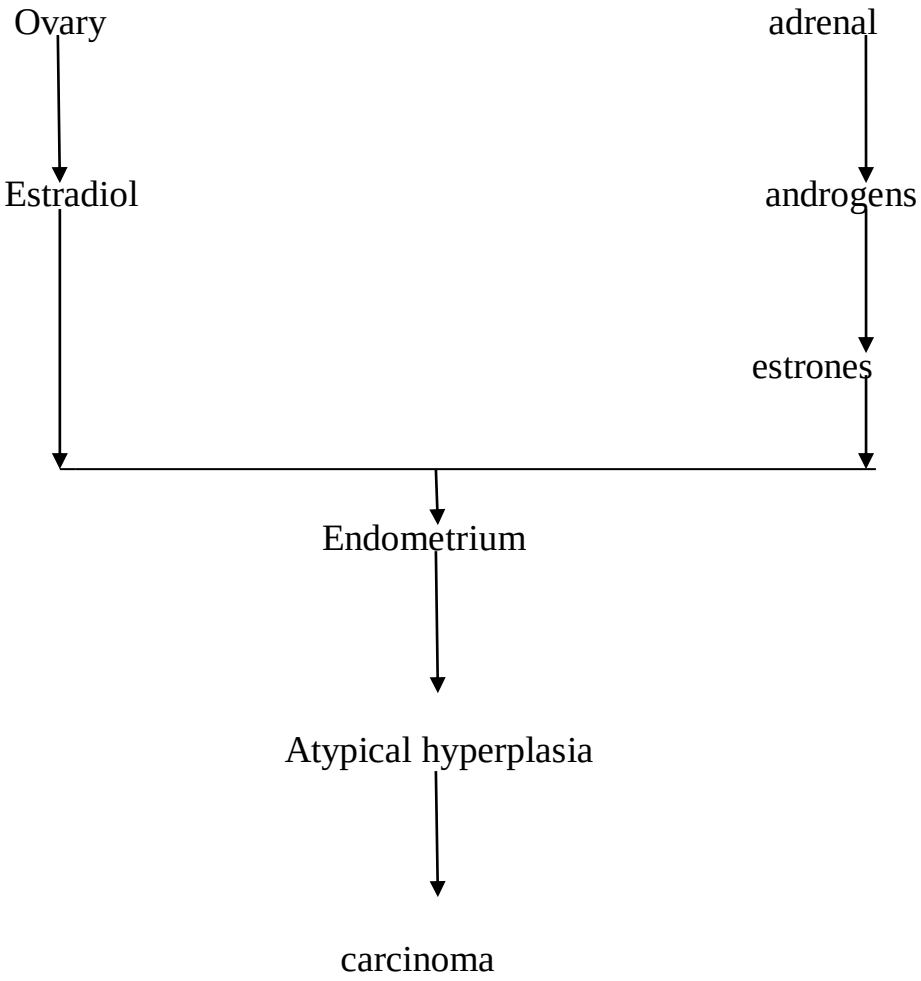
INFERTILITY

Due to chronic anovulation , women with PCOS donot conceive . Infertility is common in women with PCOS. Endometrial abnormalities and quality of oocyte also contribute to the causes of infertility in addition to anovulation

POLYCYSTIC OVARIAN SYNDROME AND ENDOMETRIAL CANCER

Increased androgen production from ovaries are converted to estrone. There is excess amount of circulating estrogen and androgen. Due to anovulation the Production of progesterone is decreased. There is unopposed action of estrogen on endometrium

Polycystic Ovarian Syndrome and Endometrial Cancer



Thus women with PCOS, have increased tendency to get endometrial cancer . They also, are at high risk of developing breast cancer due to both obesity and PCOS.

OTHER ANDROGEN EXCESS DISORDERS

PCOS is the diagnosis of exclusion, so all other conditions presenting with chronic anovulation and hyperandrogenism should be ruled out.

Thyroid disorders

Women with thyroid disorders have menstrual dysfunction , so serum thyroid stimulating hormone should be done to rule out thyroid disorders in all anovulatory women. Both hypothyroidism and hyperthyroidism patients have anovulatory cycles.

Hyperprolacinemia

Women with hyperprolactinemia have menstrual dysfunction. It is the most common cause of secondary amenorrhoea , hence women with menstrual dysfunction should be tested for prolactin levels.

Androgen secreting tumors

Both ovarian and adrenal tumors can be excluded by appropriate history and clinical examination . USG will diagnose most of the ovarian masses. Serum testosterone values more than

150ng/dl is suggestive of malignancy. Rapidly progressing virilization and hirsuitism also suggests androgen producing tumor.

Cushing syndrome

Patients with cushing syndrome have all clinical features seen in women with PCOS. Along with this , they have signs and symptoms suggestive of hypercortisolism like hypertension, striae, atrophy of muscle weakness. The best screening test is the Overnight dexamethasone suppression test .

Idiopathic Hirsuitism

Hirsuitism will be accompanied by normal ovulatory function. It results due to peripheral disorder of androgen metabolism. The condition is familial. Androgens levels are not elevated . It is due to both increase in the number of androgen receptors and also due to increased sensitivity of the receptors. Hair follicles show increased 5alpha reductase activity.

Cushing Syndrome

Figure 4

METABOLIC DISTURBANCES :

Most of the women with PCOS have metabolic derangements including dyslipidemia, insulin resistance and Obesity. They are, at increased for developing cardiovascular disease and type 2 diabetes mellitus. Insulin resistance along with obesity increase the risk of developing cardiovascular disease.

Many women with PCOS have metabolic syndrome. Metabolic syndrome is also called as metabolic syndrome X. Insulin resistance syndrome , syndrome X are the names given to it . It is also called as Revans syndrome ,named after Gerald Revan.

It is due to disruption in the normal process of energy utilization and storage resulting in metabolic abnormalities which include dyslipidemia, hypertension, insulin resistance, high fasting glucose, obesity. Atleast three of the five criteria should be present to diagnose metabolic syndrome.

Women with PCOS have insulin resistance, obesity and Hyperandrogenism which puts them under high risk for developing metabolic syndrome . The underlying factors for metabolic

syndrome are genetics[19], physical inactivity, aging and proinflammatory factors.

There are different classifications to define metabolic Syndrome. The objective of all the classification is to provide a simple diagnostic and clinical tool to identify people who have increased of developing cardiovascular disease and type 2 diabetes mellitus.

National cholesterol Education Program Adult Treatment Panel(III)[17] defines metabolic syndrome, if there are three out of the following five features

1) Waist circumference more than 88cm in females

2) Hypertension systolic BP more than 130 mmHg and diastolic BP more than 85 mmHg.

3) Triglycerides more than 150mg/dl

4) High Density Lipoprotein (HDL) less than 50mg/dl

5) Fasting blood glucose more than 110mg/dl

WHO World Health Organisation defines metabolic Syndrome as that , where along with insulin resistance any of the two following criteria be present.

1) Hypertension systolic BP more than 140 mmHg and Diastolic BP more than 90 mmHg.
2) Triglycerides more than 150mg/dl
3) High Density Lipoprotein (HDL) less than 50mg/dl
4) Obesity BMI > 30kg/m2. or waist to hip ratio > 0.85 in females
5) Microalbuminuria

International Diabetes Federation defines metabolic syndrome as central obesity , waist circumference more than 88cm in females and more than 104cm in males plus any of the two following criteria

1) Hypertension systolic BP more than 130 mmHg and Diastolic BP more than 85 mmHg
2) Triglycerides more than 150mg/dl
3) High Density Lipoprotein (HDL) less than 50mg/dl
4) Fasting blood glucose more than 110mg/dl

NCEP ATP III guidelines differ from that of WHO criteria .In WHO criteria insulin resistance is calculated , which is a cumbersome process if the study is applied to large population. In NCEP ATP III instead of insulin resistance fastin blood glucose is calculated which will give a better idea of glucose metabolism . It is of more help in predicting the progress of glucose regulation abnormalitieslike impaired glucose tolerance and diabetes mellitus.

All the factors have their own individual risk of developing cardiovascular disease. The combination of these factors further augment the chance of developing coronary heart disease and diabetes mellitus.

PCOS women have insulin resistance . Obesity further accelerates insulin resistance . In women with PCOS there is increased amount of triglycerides, decreased amount of HDL. The amount of LDL doesnot vary significantly among PCOS patients.

Obesity contributes to hypertension, high serum cholesterol like triglycerides, low HDL and impaired glucose tolerance. All these are risk factors for developing coronary heart disease.

Obesity, by itself is an individual risk factor for developing heart disease.

The final point in metabolic syndrome is hypertension . It is not found in all patients and requires some duration of time to develop. Women with Polycystic ovarian syndrome presenting with insulin resistance develop impaired glucose tolerance and also type 2 diabetes mellitus in due course of time.

TREATMENT OF PCOS

Treatment of PCOS includes life style modification, which includes diet and exercise, like moderate exercises for 30 minutes .losing weight upto 5% provides good results.

Drugs includes estrogen progesterone contraceptives, metformin and anti androgens .

Estrogen progesterone contraceptives pills decreases insulin sensitivity in women with PCOS to some extent but long term usage may increase the risk of developing type II diabetes mellitus, cardiovascular disease in women with PCOS who already have insulin resistance.

Metformin regularizes menstrual cycle and is the most important treatment in young women presenting with anovulatory cycles . Treatment with Metformin decreases the risk of developing diabetes and heart diseases.

The most appropriate candidates for treatment with Metformin are PCOS women with impaired glucose tolerance and patients with evidence of insulin resistance. Clomiphen citrate , Metformin, and GnRH agonists form the main stay of treatment in PCOS patients with infertility.

TREATMENT OF HIRSUITISM

For women with PCOS presenting with acne, hirsutuism, management options include cosmetic measures, medical treatment and surgical treatment.

Cosmetic measures

These are useful in women with idiopathic hirsuitism and also in mild hisruitism. Eflornithine hydrochloride cream which inhibits ornithine decarboxylase enzyme is used.

Medical management:

Combined oral contraceptive pills and GnRH agonists suppresses pituitary LH . COC pills also suppress the production of ovarian testosterone. Medroxy progesterone acetate suppresses pituitary LH, ovarian testosterone and also inhibits 5 alpha reductase . ketoconazole blocks adrenal and ovarian androgens . anti androgens like spironlactone, cyproterone acetate , flutamide inhibits androgen binding to receptors. Finasteride inhibits 5alpha reductase

Surgical management :

Clitoral reduction is done in women with clitoromegaly. Androgen secreting tumours are managed by hysterectomy and oophorectomy. Adrenal adenomas are treated by adrenalectomy.

INFERTILITY :

Women , who present with complaints of infertility are treated with both metformin and ovulation induction drugs like clomiphen citrate, aromatase inhibitors and gonaadotropins.

Metformin alone or in combination with other insulin senitizing agents improve the menstrual function in most women with PCOS.

Clopmiphen citrate, selective estrogen receptor modulator has both estrogen agonist and antagonist activity. Due to negative feedback of estrogen there is rise in the levels of GnRH , which in turn causes follicular development.

Laparoscopic ovarian drilling is done in women who are resistant to clomiphen and gonadotropins . It is done restore ovulatory dysfunction . Laparascopic ovarian [28] drilling is done by electrocautery and also by laser vaporization. It is done by puncturing 4 to 6 sites in single ovary. Tubo ovarian surfaces are avoided to decrease the risk of adhesions. Adhesion formation should be prevented , as it will affect the escape and pickup of ovum. It causes destruction of ovarian stroma which in turn decreases the production androgen from ovaries. There is decrease in the levels of both testosterone and androstenedione.

TREATMENT OF OBESITY

Treatment of obesity includes lifestyle therapy, pharmaceuticals like metformin, anti obesity drugs and bariatric surgery. Lifestyle[28] therapy remains the main mode of treatment of obesity. Lifestyle therapy includes both dietary component exercise and increased physical inactivity.

Aerobic exercises for a period of 150 minutes in a week is recommended. It is done in divided sessions.

Diet therapy includes restriction of calories to about 500kcal. This restriction of 500 kcal/day reduces the weight by 1pound per week[29]. Diet low in carbohydrate is also associated with profound weight loss.

The are many studies in women with PCOS, stating the use of metformin is associated with weight loss. There is a meta analysis that supports the use of metformin.The only drug approved by Food and Drug Administration to treat obesity is Orlistat[30]. The mechanism of action of Orlistat is that inhibits the activity of intestinal lipase and it inhibits the absorption of fat. The amount of weight loss after one year use is 5-7lbs[23]. Bariatric

surgery is done for morbidly obese patients with PCOS. Studies have proved that long term survival is superior with bariatric surgery when compared without surgery[31].

TREATMENT OF METABOLIC SYNDROME

The main objective to treat metabolic syndrome is to prevent the development of coronary heart disease, and type 2 diabetes mellitus. Other risk factors contributing to the development of cardiovascular disease like smoking should be stopped. Long term and short term complications can be prevented by appropriate life style modifications. These include

- Weight loss upto 10% . BMI of less than 25kg/m2 should be maintained.
- Moderate physical exercise of about 30 minutes
- Diet should include reduced amount of salt, saturated fatty acids and more amount of polyunsaturated fatty acids.
- Each individual has to be treated according to the features they have.

Treatment of insulin resistance

Diet and exercise forms the main stay of treatment. In patients having impaired glucose tolerance the use of insulin sensitizing agents like metformin are used. Metformin and other insulin sensitizing agents slow down the progress of both insulin resistance and impaired glucose tolerance to diabetes mellitus. Acarbose is also used. Patients with type 2 diabetes mellitus are treated with insulin.

Treatment of Lipid Abnormalities

Lipid disturbances respond well to exercise and weight loss along with drug therapy. The main aim is to treat increased LDL levels. Later increased triglycerides and reduced HDL levels are treated. Statin group of drugs along with niacin , and fibrate are used to treat lipid abnormalities.Fibrates decrease the LDL levels , increase HDL levels and also decrease TGL levels

Prevention of thromboembolic disorders

Patients having metabolic syndrome are more prone for thrombosis due to disorders in clotting mechanism . They are treated with low dose aspirin to prevent thrombotic events.

Treatment of hypertension

Hypertension forms an important risk factor for developing metabolic syndrome. Maintaining blood pressure at adequate levels improves the general outcome.

Angiotensin converting enzyme inhibitors and Angiotensin receptor blockers are used to treat hypertension.

Prevention

Prevention of metabolic syndrome is mainly by adopting healthy lifestyle which includes balanced diet, moderate amount of exercise lasting for atleast 30 mts. Women with family history of diabetes or metabolic syndrome should be counselled about the complications and should be advised to adopt healthy lifestyle at the earliest.

ACANTHOSIS NIGRICANS

Linear velvety pigmented lesions due to insulin resistance. It appears on nape of neck and axilla.

Figure 5

POLYCYSTIC OVARIES

Laparascopic finding of polycystic ovaries

They appear as enlarged and pearly white with multiple follicles

Figure 6

Laparascopic view of polycystic ovaries

METHODOLOGY

STUDY DESIGN

Prospective , descriptive, cross sectional study to determine the prevalence of metabolic syndrome in patients with PCOS.

STUDY PLACE

Gynaecology Outpatient deparment, Department of Obstetrics and Gynaecology Government kilpauk Medical college Hospital, Chennai -10

STUDY POPULATION

All patients who satisfied the inclusion and exclusion criteria below, after obtaining consent were included in the study and those in exclusion criteria were deleted from the study.

INCLUSION CRITERIA

1. Women in the age group 18-45 years
2. Patients presenting with menstrual abnormalities

   Oligomenorrhoea (absence of menses for 35-182 days) and amenorrhoea(absence of menses > 182 days)

3. Women presenting with clinical evidence of hyperandrogenism like hirsuitism, acne, temporal balding]

4. Women with (acanthosis nigricans)

5. USG evidence of polycystic ovaries

EXCLUSION CRITERIA

1. Pregnancy

2. Hyperprolactinemia

SAMPLE SIZE

Sample size was calculated from the formula

$N = z^2p (1-q)/ E^2$

N is sample size

Z is constant , point corresponding to significant level of 5% z = 1.96

P is prevalence of metabolic syndrome (assumed) is 14% p= .14

Q = 1-P = (1-.14)= .86

E is maximum likely error 5%

N = 1.96*1.96*.14*.86/.05*.05 = 185

Sample size is 185

ETHICAL CLEARANCE

Ethical committee clearance was obtained from the Ethical committee , Kilpauk medical college. All the patients included in the study were informed about the study and consent was obtained before eliciting history and collecting sample for lab tests.

STUDY PROCEDURES

Patients attending gynaecology department in the age group 18-45 were screened for menstrual complaints. Patients with complaints of oligomenorhoea and amenorrhoea were enrolled in the study. Detailed history was taken and clinical examination done . During examination, clinical evidence of hyperandrogenism if present was noted. Hirsutism was established by using the modified Ferriman–Gallwey score.

Transvaginal ultrasonography was systematically performed in logic mindray, using the 7.5 MH z transvaginal probe. Ovarian volume measurements were carried out by using three perpendicular dimensions and applying the equation for the volume of an ellipsoid . Antral follicles were measured in

three dimensions and those with a mean diameter of 2–9 mm counted.

Other disorders like hypothyroid, and hyperprolactinemia causing menstrual abnormalities were ruled out by measuring serum TSH levels and prolactin levels. Patients who satisfied Rotterdam criteria of PCOS were taken as study participants.

Rotterdam criteria for PCOS is as follows , atleast two of the three major criteria should be present.

1) Oligomenorrhoea

2) Clinical or biochemical hyperandrogenism

3) Polycystic ovaries (USG) , excluding other androgen excess

Clinical Measurements

Weight of the participants was measured using the Secca weighing scale. Calibration was done every morning before starting the work using a standard weight. Weight was taken without shoes and in light clothing. Reading was measured to the nearest 0.5 kilograms.

Height assessment was done using a height measuring rod without shoes and recorded to the nearest 0.5 centimeters.

BMI for each person was calculated by dividing weight (kilograms) with height squared(meter).

BMI of 30kg/m2 and over, was taken as obesity.

Waist circumference was also taken using a non-stretchable tape measure at level of the uppermost edge of the hip bone on a light clothed abdomen with the tape parallel to the ground and recorded to the nearest 0.5 centimeters. The measurement above 88cm was considered as central obesity. This was according to the IDF & NCEP ATP III criteria

Blood Pressure Measurements:

Blood pressure was taken from the arm (brachial artery) from all patients in the first encounter by using digital sphygmomanometer.

Blood pressure measurement was done in a sitting position with the arm supported andrepeated after 5 minutes; the average of the two measurements was taken as a blood pressure.

The systolic pressure of above or equal to140mmHg and diastolic pressure above or equal to 90mmHg was regarded as a high blood pressure.

Those who found to have high BP were referred to a physician for further evaluation and possible treatment

After an overnight fasting, blood samples for high density lipoproteins (good cholesterol), serum triglycerides and blood glucose was collected. Five millilitres of venous blood was taken from the antecubital fossa and placed in empty sterile tubes. The samples were transported to the laboratory.

DIAGNOSTIC CRITERIA

In this study National Cholesterol Education Programme ATP III criteria of metabolic syndrome was used. According to this criteria atleast three of the following five criteria should be present

1) Waist circumference more than 88cm in females and more than 104cm in males.
2) Hypertension systolic BP more than 130 mmHg and

   Diastolic BP more than 85 mmHg.

3) Triglycerides more than 150mg/dl

4) High Density Lipoprotein (HDL) less than 50mg/dl

5) Fasting blood glucose more than 110mg/dl

Patients with high blood pressure were referred to physician. Patients with increased fasting blood glucose, high TGL, low HDL levels were advised to repeat the blood investigations and patients with persistence high values were referred to physician.

DATA ANALYSIS

Collected data was entered into computer statistical program. Analysis was done using SPSS version 15. Comparison of variables was done using chi square test. P value of less than .05 was taken as statistical significance.

AGE GROUP AND METABOLIC SYNDROME (MS)

The association between age and prevalence of metabolic syndrome was evaluated. Patients were divided into four age groups.

Table 1 AGE GROUP AND METABOLIC SYNDROME (MS)

Age group		Metabolic syndrome		
		Present	**Absent**	**Total**
1	Count	0	11	11
	%within MS	0	6.7%	6.7%
	Total %	0	5.7%	5.7%
2	Count	6	57	63
	%within MS	20.7%	34.5%	32.5%
	Total %	3.1%	29.4%	32.5%
3	Count	19	87	106
	%within MS	65.5%	52.7%	54.6%
	Total %	9.8 %	44.8%	54.6%
4	Count	4	10	14
	%within MS	13.8%	6.1%	7.2 %
	Total %	2.1%	5.2 %	7.3%
TOTAL COUNT		29	165	194
% within MS		100%	100%	100%

Age of 20 -25 were in the first group, in second group patients were in the age group 26-30,third group had patients between age 31-35 , fourth group had patients in the age group 36-40years.

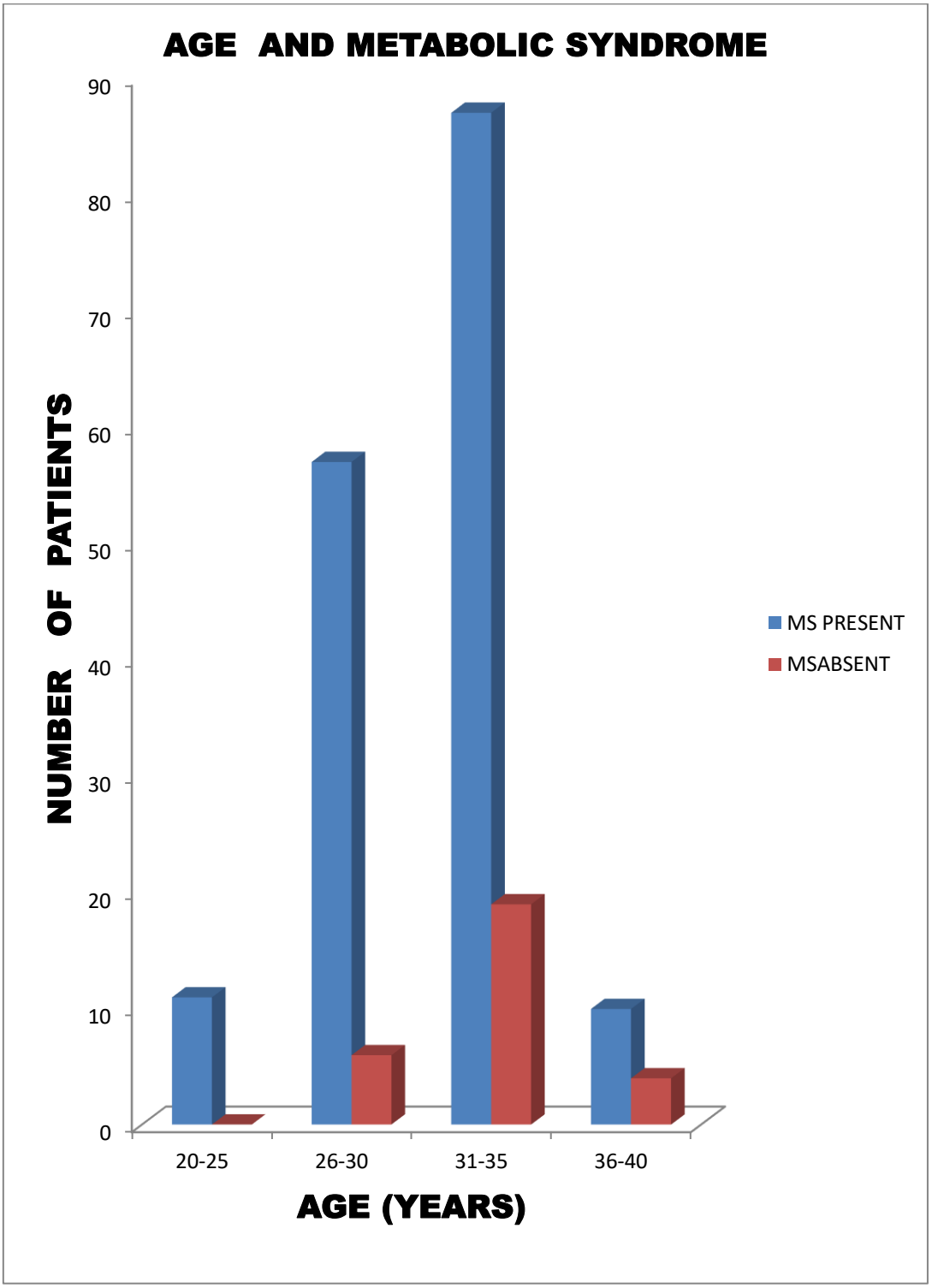
Majority of patients , about 107 of them were in the age group of 31-35 years. About 63 patients fell in the age group of 26-30years. 14 were in the age group 36-40 years and 11 were in the age group 21-25.

Among 107 patients, 19 had metabolic syndrome. Out of 63 patients, 6 had metabolic syndrome. Out of 14 patients 11 had metabolic syndrome. The age group analysis was made using chi - square test.

P value was found to be 0.103

The association was not found to be statistically significant.

Figure - 7


AGE AND METABOLIC SYNDROME
NUMBER OF PATIENTS
90
80
70
60
50
40
30
20
10
0
20-25
26-30
31-35
36-40
AGE (YEARS)
MS PRESENT
MSABSENT

Polycystic ovaries and Metabolic Syndrome

Among 194 patients 185 patients had USG evidence of polycystic ovaries. Out of this 20 patients had metabolic syndrome. Polycystic ovaries were absent in 9 patients , but all the 9 patients had metabolic syndrome.

TABLE 2

Polycystic ovaries and Metabolic Syndrome

Polycystic ovaries(USG)		**Metabolic Syndrome**		
		Absent	**Present**	**Total**
Absent	Count	0	9	9
	%within MS	0	31%	4.6%
	Total %	0	4.6%	4.6%
Present	Count	165	20	185
	%within MS	100%	69%	95.4%
	Total %	85.1%	10.3%	95.4%
TOTAL	COUNT	165	29	194
	% within MS	100%	100%	100%
	Total %	85.1%	14.9%	100%

Relationship between the usg evidence of polycystic ovaries and metabolic syndrome was evaluated using chisquare test and Fisher's exact test . The p value was found to be <.05 .

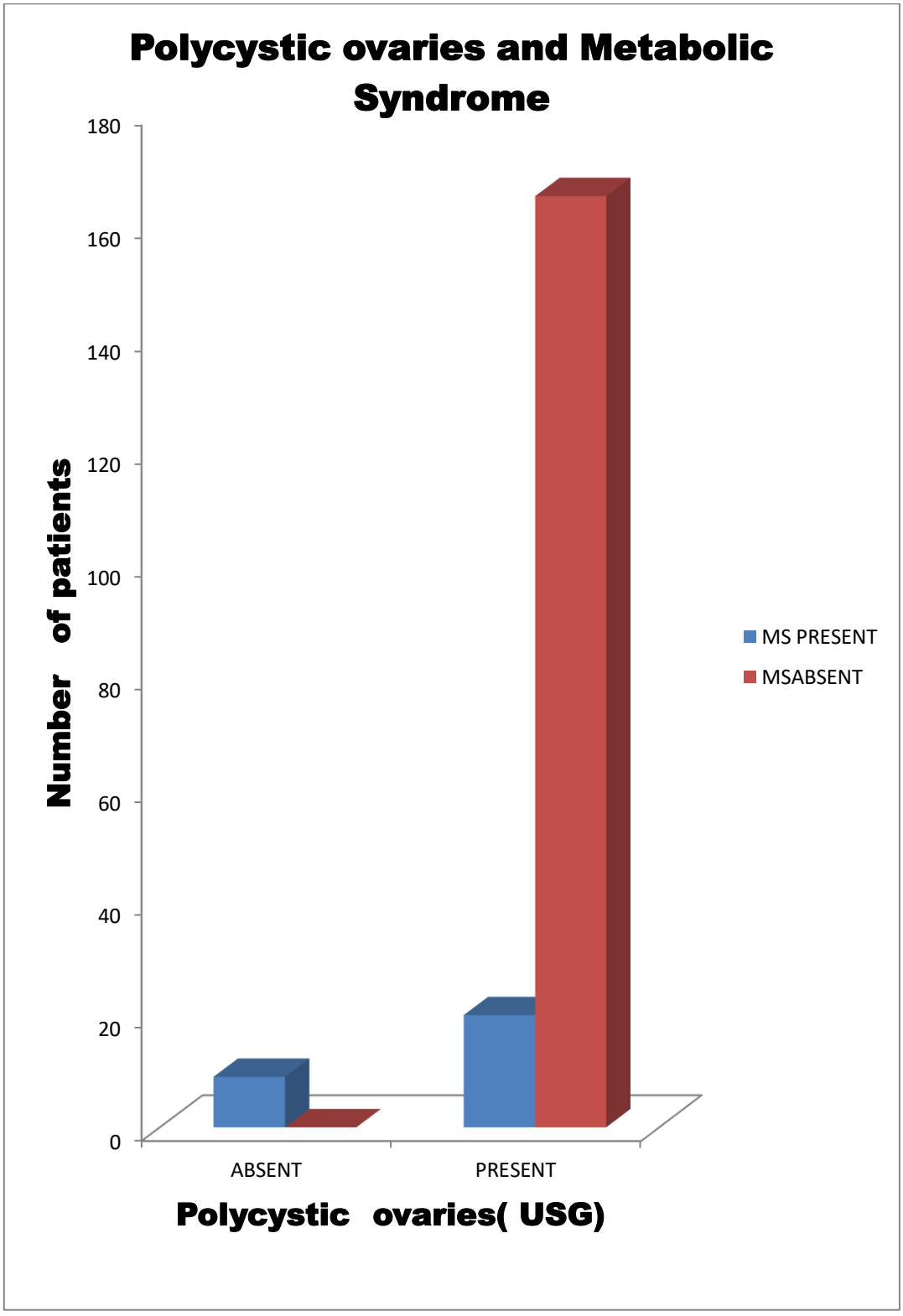
The relationship was found to be statistically significant

TABLE 3

Chi-Square Tests

	Value	**Df**	**Asymp. Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	53.698[a]	1	.000		
Continuity Correction[b]	46.912	1	.000		
Likelihood Ratio	36.923	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	53.421	1	.000		
N of Valid Cases	194				

Figure – 8


Polycystic ovaries and Metabolic Syndrome
180
160
140
120
100
80
60
40
20
0
Number of patients
MS PRESENT
MSABSENT
ABSENT
PRESENT
Polycystic ovaries(USG)

HIRSUITISM AND METABOLIC SYNDROME**.**

Hirsuitism was present in 101 patients and absent in 93 patients. Among 101 patients 28 patients had metabolic syndrome. In 93 patients only 1 patient had metabolic syndrome.

TABLE 4

Hirsuitism and Metabolic Syndrome

Hirsuitism		**Metabolic Syndrome**		
		Absent	**Present**	**Total**
Absent	Count	92	1	93
	%within MS	55.8%	3.4%	47.9%
	Total %	47.4%	.5%	47.9%
Present	Count	73	28	101
	%within MS	44.2%	96.6%	52.1%
	Total %	37.6%	14.4%	52.1%
TOTAL	COUNT	165	29	194
	% within MS	100%	100%	100%
	% of Total	85.1%	100%	100%

Relationship between hyperandrogenism and metabolic syndrome using hirsuitism was evaluated by chi-square test.

P-value was found to be less than .05.

The association was found to be statistically significant .

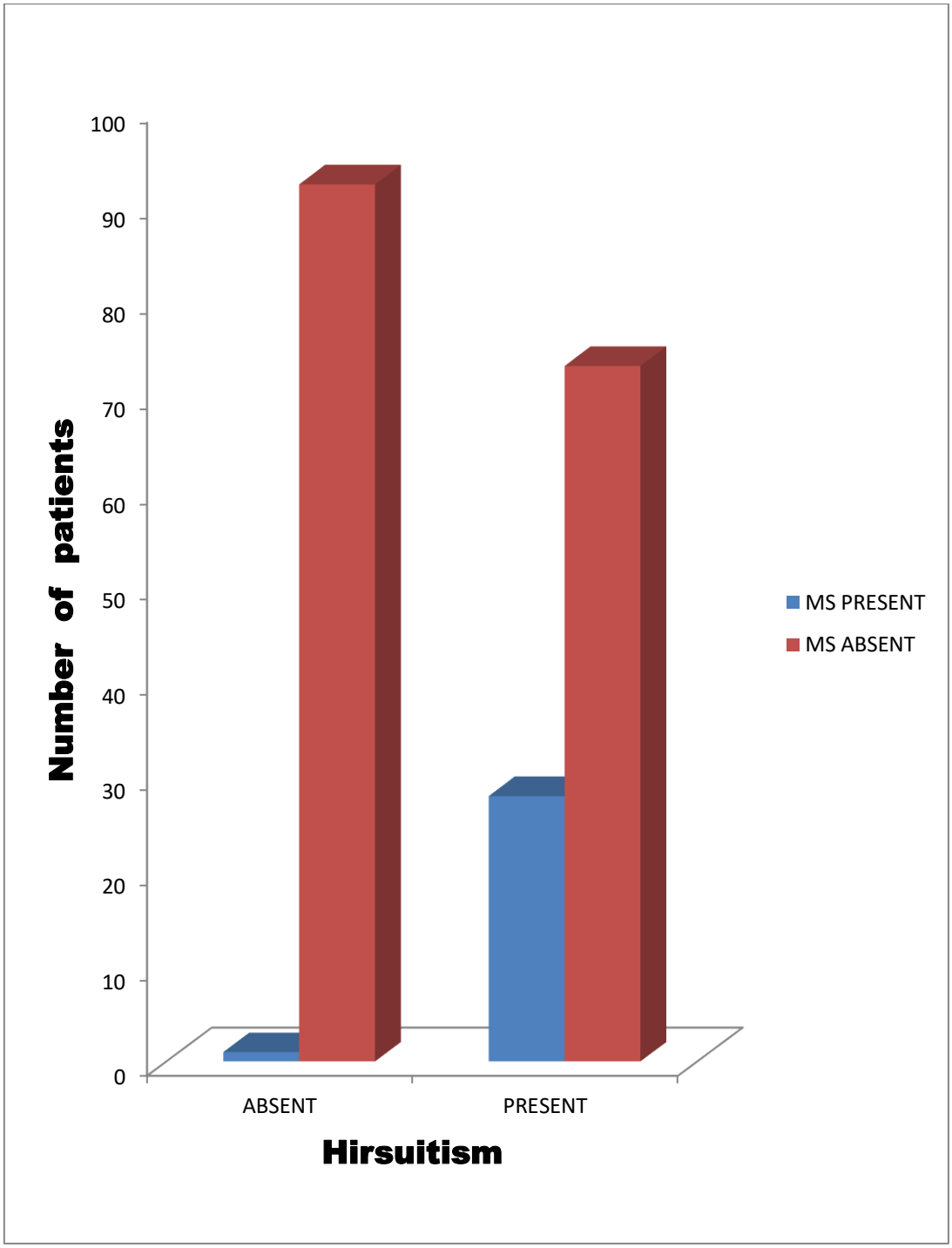
TABLE 5

Chi-Square Tests

	Value	**df**	**Asymp. Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	27.042[a]	1	.000		
Continuity Correction[b]	24.987	1	.000		
Likelihood Ratio	33.366	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	26.903	1	.000		
N of Valid Cases	194				

Figure - 9

Hirsuitism and Metabolic Syndrome



ACANTHOSIS NIGRICANS AND METABOLIC SYNDROME

Among 194 patients , acanthosis nigricans which is an evidence of insulin resistance was present in 14 patients. Out of 14, ten patients had metabolic syndrome.

TABLE 6

Acanthosis Nigricans and Metabolic Syndrome

Acanthosis Nigricans		**Metabolic Syndrome**		
		Absent	**Present**	**Total**
Absent	Count	161	19	180
	%within MS	97.6%	65.5%	92.8%
	Total %	83%	9.8%	92.8%
Present	Count	4	10	14
	%within MS	2.4%	34.5%	7.2%
	Total %	2.1%	5.2%	7.2%
TOTAL	COUNT	165	29	194
	% within MS	100%	100%	100%
	% of Total	100%	100%	100%

The association between acanthosis nigricans and metabolicsyndrome was evaluated using chisquare test.

p- value was found to be < .05. The relationship was to be statistically significant.

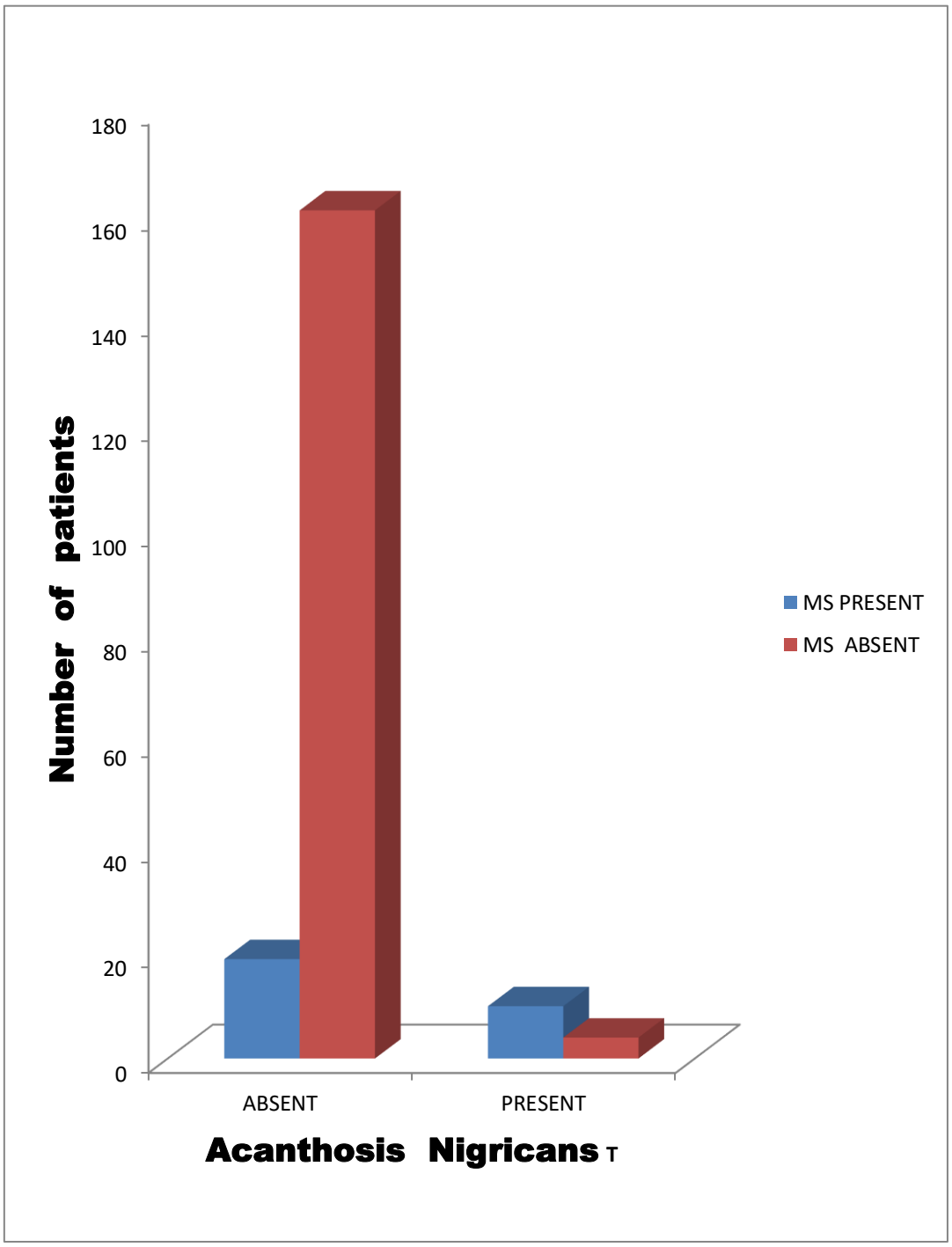
TABLE 7

Chi-Square Tests

	Value	**Df**	**Asymp. Sig. (2-sided)**	**Exact Sig. (2-sided)**	**Exact Sig. (1-sided)**
Pearson Chi-Square	37.859[a]	1	.000		
Continuity Correction[b]	33.223	1	.000		
Likelihood Ratio	25.549	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	37.664	1	.000		
N of Valid Cases	194				

Figure 10

Acanthosis Nigricans and Metabolic Syndrome



PCOS AND METABOLIC SYNDROME

Patients with polycystic ovarian syndrome were divided into three groups . The first group had patients who satisfied all three criteria of Rotterdam (ie) 1.hyperandrogenism, 2.anovulation 3. usg evidence of polycystic ovaries .

TABLE 8

PCOS and Metabolic Syndrome

Age group		Metabolic syndrome		
		Present	**Absent**	**Total**
5	Count	0	11	11
	%within MS	0	6.7%	6.7%
	Total %	0	5.7%	5.7%
6	Count	6	57	63
	%within MS	20.7%	34.5%	32.5%
	Total %	3.1%	29.4%	32.5%
7	Count	19	87	106
	%within MS	65.5%	52.7%	54.6%
	Total %	9.8 %	44.8%	54.6%
TOTAL COUNT		29	165	194
	% within MS	100%	100%	100%

Second group had patients with anovulation and usg evidence of polycystic ovaries.Third group constituted patients with anovulation and hyperandrogenism. Number of patients with metabolic syndrome in first , second and third group were 20, 1, and 8 respectively.

The risk of developing metabolic syndrome between the three groups were assesed using chisquare test . There was difference in risk between the three groups . The difference was found to be stastistically significant. From the above analysis it can be concluded that clinical hyperandrogenism is important risk factor in developing metabolic syndrome.It can also be concluded that all patients with usg evidence of polycystic ovaries donot necessarily develop, metabolic syndrome.

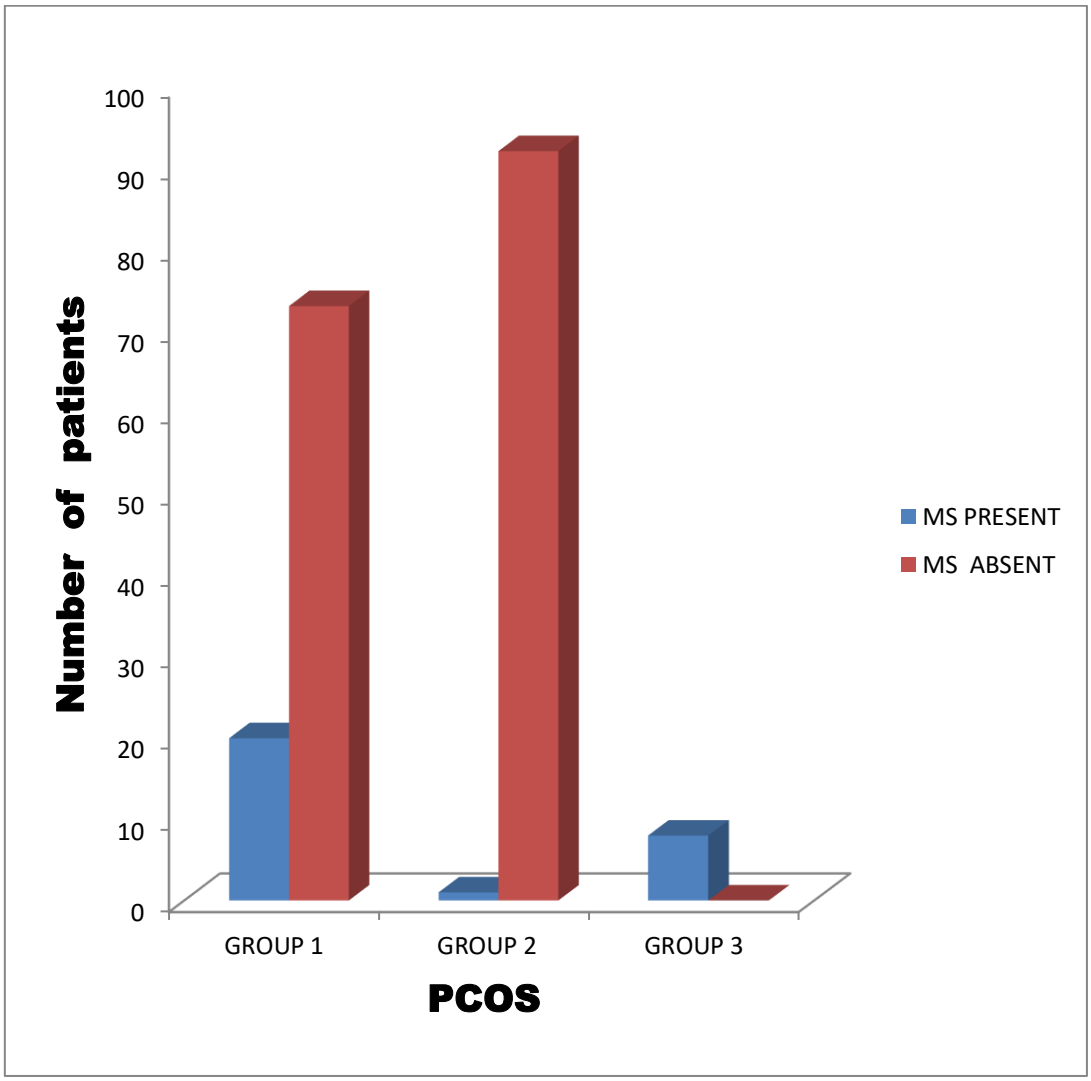
TABLE 9

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	62.741[a]	2	.000
Likelihood Ratio	55.782	2	.000
Linear-by-Linear Association	.061	1	.805
N of Valid Cases	194		

Figure 11

PCOS and Metabolic Syndrome



Relationship between patients with and without metabolic syndrome was analysed. It was analysed using independent t test.

Table 10 Group Statistics

	MS	N	Mean	Std. Deviation	Std. Error Mean
Age	1	29	32.41	2.872	.533
	0	165	30.66	3.652	.284
BMI	1	29	24.28	1.099	.204
	0	164	22.40	1.849	.144
Waist circumference	1	29	93.03	3.311	.615
	0	165	87.02	5.534	.431
Sys BP	1	29	130.52	15.256	2.833
	0	165	109.76	7.647	.595
Dias BP	1	29	83.10	10.037	1.864
	0	165	70.85	5.988	.466
FBS	1	29	92.69	18.517	3.438
	0	165	83.32	7.414	.577
TGL	1	28	147.11	10.874	2.055
	0	165	138.75	7.371	.574
HDL	1	29	47.07	3.741	.695
	0	165	54.79	2.869	.223

The variables taken for analysis were age group, systolic BP, diastolic BP, HDL, TGL, waist circumference, BMI and fasting blood glucose level.

Except age group, all other variables contributed to the difference between patients with and without metabolic syndrome and they were statistically significant .

Of all these variables, waist circumference had a strong correlation towards metabolic syndrome. All patients with metabolic syndrome had increased waist circumference.

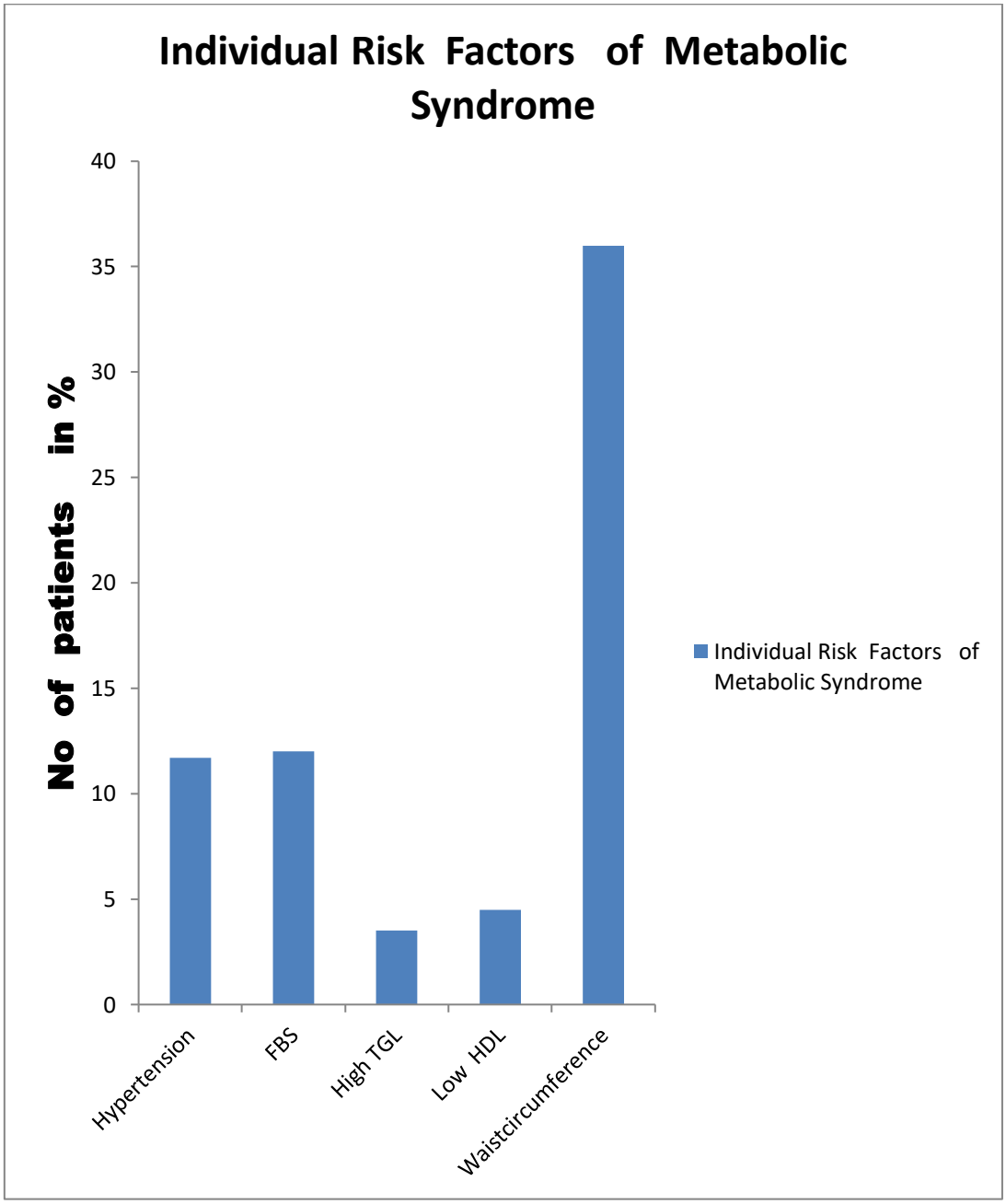
p- value was found to be less than .05 for all the variables and the co-relation was found to be statistically significant

Table 11

Independent Samples Test

		t-test for Equality of Means		
		df	Sig. (2-tailed)	Mean Difference
AGE	Equal variances assumed	192	.015	1.753
	Equal variances not assumed	45.539	.006	1.753
BMI	Equal variances assumed	191	.000	1.873
	Equal variances not assumed	60.481	.000	1.873
WAIST CIRCUMFERENCE	Equal variances assumed	192	.000	6.016
	Equal variances not assumed	59.787	.000	6.016
SYS BP	Equal variances assumed	192	.000	20.760
	Equal variances not assumed	30.517	.000	20.760
DIAS BP	Equal variances assumed	192	.000	12.255
	Equal variances not assumed	31.592	.000	12.255
FBS	Equal variances assumed	192	.000	9.375
	Equal variances not assumed	29.596	.012	9.375
TGL	Equal variances assumed	191	.000	8.362
	Equal variances not assumed	31.343	.000	8.362
HDL	Equal variances assumed	192	.000	-7.719
	Equal variances not assumed	34.024	.000	-7.719

Figure 12


Individual Risk Factors of Metabolic Syndrome
No of patients in %
40
35
30
25
20
15
10
5
0
Hypertension
FBS
High TGL
Low HDL
Waistcircumference
Individual Risk Factors of Metabolic Syndrome

Individual risk factors of each component for metabolic syndrome is as follows

- Hypertension 11.7%
- High FBS 12%
- Increased waist circumference 36%
- Low HDL 17.6%
- High TGL 8.8%

DISCUSSION

The main objective of this study is to determine the prevalence of metabolic syndrome in women diagnosed as PCOS according to the Rotterdam criteria. The main findings are that the overall prevalence of syndrome is 16.1%. Moreover, within this anovulatory cohort, the hyperandrogenic PCOS phenotype is associated with the highest risk of metabolic abnormalities.

In comparison to other studies with similarly diagnosed PCOS women, the prevalence of metabolic abnormalities in our study group is lower.prevalence is 35–44% in American (Shroff et al., 2007) and Australian anovulatory PCOS women (Cussons et al., 2008), comparable to the 16% reported in

Taiwanese anovulatory PCOS women (Chen et al., 2006), but higher than the 8.2% reported in Southern Italian women with anovulatory PCOS (Carmina et al., 2006).

The prevalence of risk factors for metabolic syndrome in this study showed that obesity was the most important.

Low level of HDL-C and impaired fasting glucose were the most frequent (17.6% and 11.4% respectively) components of metabolic syndrome. This could make the population to have greater odds of having cardiovascular disease and type 2 diabetes .

Systemic hypertension was also found to be one of the most components of MS by 11.7%. The findings were similar in studies done in Nigeria and Cameroon.

Elevated level of serum triglyceride was frequent in 8.8% subjects. This was contrary to what had been shown in a study done in Sub Saharan Africa where elevated triglyceride was the least risk factor.

SUMMARY AND CONCLUSION

This prospective cross sectional descriptive study evaluated 194 patients with PCOS by both clinical and labarotory tests, following the inclusion and exclusion criteria at Government kilpauk Medical college

In this prospective study of 194 patients with PCOS, according to Rotterdam criteria the prevalence of metabolic syndrome was found to be 16.1%.

In this study patients with PCOS were classified into three groups.

First group had patients who satisfied all three criteria like menstrual abnormalities, hyperandrogenism, and USG evidence of Polycystic ovaries .

Second group were patients with menstrual irregularities and usg evidence of polycystic ovaries.

Third group constituted women with hyperandrogenism and menstrual irregularities.

Prevalence of metabolic syndrome in each group are as follows.

Prevalence in first group 21%

Prevalence in second group 1%

Prevalence in third group is 100%

Out of 194 patients 29 patients had metabolic syndrome.

Out of 29 patients, I patient met all five criterias.

10 out of 29 patients met 4 criterias.

18 patients met 3 criterias.

Odds ratio for acanthosi nigricans with reference to metabolic syndrome was found to be 21.

Odds ratio for hirsuitism with reference to metabolic syndrome was found to be 35

Hyperandrogenism is important risk factor in developing metabolic syndrome.

Individual risk factors of each component for metabolic syndrome isas follows

- Hypertension 11.7%
- FBS 12%
- Increased waist circumference 36%
- HDL 17.6%
- TGL 8.8%

All patients with metabolic syndrome had increased waist circumference.

Hence all PCOS women with clinical hyperandrogenism and increased waist circumference should be screened for metabolic syndrome.

Women at risk of developing metabolic syndrome should be adviced about lifestyle modifications .

Life style therapy forms the main stay of treatment for both PCOS and metabolic syndrome.

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PROFORMA

- Name :
- Age :
- Occupation :
- Address :
- OP No. :
- Age of menarche :
- Married :
- Menstrual history : Cycle

  Duration of flow

  Amount

  Pain
- Family History of TB/ DM / HT : Yes / No
- General Examination :
- Height
- Weight
- BMI
- Breasts
- Thyroid

- Hirsuitism
- Acne
- Acanthosis Nigricans
- BP
- Waist circumference
- External genitalita
- Speculum examination :
- Bimanual pelvic Examination
- Uterus - Normal / Enlarged / Atrophic / Absent

  Position - AV / RV
- Investigations
- Fasting blood sugar
- High Density Lipoprotein
- Triglycerides
- Serum TSH
- Serum Prolactin

MASTER CHART

S.NO	NAME	AGE	MENST CYCLES	PCO(USG)	H	AN	BMI	WC	SBP	DBP	FBS
1	JAYALAKSHMI	28	Oligo	1	0	0	23	83	110	70	88
2	SATHYA	35	Oligo	1	0	0	23	85	110	60	79
3	SIJIMA	31	Oligo	1	1	1	24	90	140	90	114
4	JAYALAKSHMI	32	Oligo	1	1	0	24	91	120	80	74
5	RAMITHA	33	Oligo	1	1	0	25	94	140	90	77
6	AMUDHA	34	Oligo	1	1	0	25	95	140	90	79
7	SRIDEVI	33	Oligo	1	0	0	24	88	100	60	82
8	KANCHANA	32	Oligo	1	0	0	23	86	100	70	88
9	SRIDEVI	27	Oligo	1	0	0	23	83	110	70	89
10	TAMILARASI	26	Oligo	1	0	0	22	82	120	80	90
11	THARAMANI	24	Ameno	1	0	0	22	80	110	70	74
12	ARUL	34	Oligo	1	0	0	22	81	120	70	79
13	MAGESHWARI	33	Oligo	1	0	0	21	79	120	80	80
14	KALPANA	32	Oligo	1	1	1	26	98	110	60	120
15	SELVI	27	Oligo	1	0	0	19	75	110	60	70
16	JANSIRANI	24	Oligo	1	0	0	20	80	100	60	79
17	YAMINI	28	Oligo	0	1	0	25	93	140	90	82
18	INDRA	29	Oligo	1	0	0	19	77	100	60	60
19	SUMATHY	32	Oligo	1	0	0	19	78	120	80	84
20	PREMALAKSHMI	26	Oligo	1	0	0	19	79	110	70	88
21	AMBIKA	34	Oligo	1	0	0	19	80	110	70	89
22	LALITHA	35	Oligo	1	0	0	20	82	100	60	85
23	MAHESHWARI	32	Oligo	1	0	0	21	83	120	80	90
24	TAMILSELVI	36	Oligo	1	0	1	24	89	110	70	119
25	VAISHNAVI	32	Oligo	1	0	0	24	86	120	80	79
26	SELVI	31	Oligo	1	0	0	25	88	110	70	83

27	GOVINDAMMAL	32	Oligo	1	0	0	25	89	120	70	85
28	PAVITHRA	28	Oligo	1	1	1	26	90	100	60	112
29	SELVI	27	Oligo	1	1	0	25	94	100	70	85
30	SHANTHI	33	Oligo	1	1	0	25	95	120	80	83
31	KASTHURI	35	Oligo	1	1	0	24	90	140	90	86
32	REVATHY	36	Oligo	1	1	0	24	89	120	80	88
33	SUSEELA	37	Oligo	0	1	0	24	95	150	90	89
34	RANI	37	Oligo	1	0	0	23	84	110	70	90
35	VIJAYA	34	Oligo	1	0	0	19	77	120	80	85
36	MEENA	34	Oligo	1	1	0	26	98	110	80	87
37	RATHA	32	Oligo	1	1	0	26	99	120	70	83
38	LATHA	32	Ameno	1	1	0	24	91	100	70	82
39	KALAIVANI	28	Oligo	1	1	0	23	87	100	60	85
40	BANU	26	Oligo	1	0	0	23	86	100	70	70
41	FOWSIA	26	Oligo	1	1	0	24	89	120	80	77
42	NALINI	22	Oligo	1	0	0	22	84	100	70	74
43	SARASWATHY	22	Oligo	1	0	0	23	85	120	70	75
44	RATHI	35	Oligo	0	1	0	25	93	150	90	72
45	MOHANA	28	Oligo	1	0	0	22	83	100	70	80
46	DEVIPRIYA	30	Oligo	1	0	0	23	87	100	70	90
47	SAKUNTHALA	31	Oligo	1	1	0	23	88	120	80	89
48	ANUSUYA	34	Oligo	1	1	0	24	89	120	80	83
49	ANANDHI	33	Oligo	1	0	0	23	86	100	60	88
50	SAMYUKTHA	32	Oligo	1	0	0	23	87	100	60	87
51	HEMAMALINI	32	Oligo	1	1	0	24	89	120	60	81
52	PARVATHY	34	Ameno	1	1	0	24	90	100	60	75
53	USHA	35	Oligo	1	1	0	24	91	100	60	72
54	SUBASHINI	36	Oligo	1	1	0	24	92	100	60	79
55	KANCHANA	34	Oligo	1	1	0	25	94	140	90	81

56	SUBHA	33	Oligo	1	1	0	26	95	110	70	86
57	SAVITHIRI	32	Oligo	1	1	0	25	92	110	70	82
58	CHITRA	31	Oligo	1	1	0	24	90	120	80	89
59	SHAMMEMMA	30	Oligo	1	0	0	22	81	100	60	90
60	MEENATCHI	27	Oligo	1	1	0	24	89	100	60	89
61	GOMATHY	26	Oligo	1	1	0	23	88	110	60	73
62	DEEPA	29	Oligo	0	1	0	24	89	140	90	72
63	GOWRI	30	Oligo	1	0	0	23	86	110	60	77
64	HEMALATHA	31	Oligo	1	1	0	23	88	110	70	79
65	VISALAKSHI	32	Oligo	1	0	0	22	82	110	70	80
66	KANNIYAMMAL	35	Oligo	1	1	0	23	89	100	70	73
67	SHANTHA	33	Oligo	1	1	0	23	90	110	70	75
68	RAMYA	32	Oligo	1	1	0	24	85	100	70	90
69	MANJULA	30	Oligo	1	0	0	23	83	120	80	82
70	RAMALAKSHMI	34	Oligo	1	0	0	23	87	110	80	87
71	PAULIYA	33	Oligo	1	0	0	19	82	120	80	89
72	VASUKI	32	Oligo	1	1	0	24	90	100	70	90
73	DEVIPRIYA	30	Oligo	1	1	1	24	91	110	70	110
74	ANITHA	31	Oligo	1	1	0	24	93	100	70	83
75	SULOCHANA	29	Oligo	1	1	0	23	99	110	70	82
76	MAHALAXMI	31	Oligo	1	1	0	25	94	110	70	85
77	ANJANA	30	Oligo	1	1	0	24	96	110	70	88
78	VIDHYA	34	Oligo	1	1	0	24	90	110	70	89
79	MEGALA	32	Oligo	1	0	0	19	77	110	70	90
80	SARRAL	33	Oligo	0	1	1	25	96	110	70	116
81	TAMILSELVI	26	Ameno	1	0	0	19	79	110	70	82
82	BARATHI	26	Oligo	1	0	0	21	82	110	70	81
83	NIRMALA	27	Oligo	1	0	0		86	100	70	80
84	JAYA	28	Oligo	1	0	0	22	84	100	70	85

85	AKILA	25	Oligo	1	0	0	23	88	120	70	89
86	LAKSHMI	27	Oligo	1	1	0	23	89	110	70	90
87	KARPAGAM	21	Oligo	1	1	0	24	90	110	70	84
88	VEENA	29	Oligo	1	1	0	24	91	120	70	82
89	SHANTHI	26	Oligo	1	1	0	24	94	110	70	85
90	PRIYA	29	Oligo	1	1	0	24	95	100	70	80
91	HEMA	30	Oligo	1	1	0	26	97	110	70	82
92	DEVIKALA	31	Oligo	1	1	0	25	90	100	70	84
93	NATHIYA	32	Oligo	0	1	1	24	94	100	70	123
94	SHEELA	32	Oligo	1	1	0	25	96	100	70	86
95	BABY	34	Oligo	1	1	0	23	90	100	70	89
96	VASANTHI	36	Oligo	1	1	0	24	91	110	70	85
97	PARIMALA	35	Oligo	1	1	0	24	92	110	70	82
98	JOTHY	26	Ameno	1	1	0	23	94	110	70	80
99	LAKSHMI	23	Oligo	1	0	0	22	89	110	70	77
100	ARCHANA	34	Oligo	1	1	0	22	88	120	70	74
101	BARANI	32	Oligo	1	0	0	22	87	110	70	72
102	MUBEENA	33	Oligo	1	0	0	22	85	110	70	70
103	MALAR	35	Oligo	1	0	0	22	87	110	70	76
104	DHANALAKSHMI	37	Oligo	1	1	0	23	89	110	70	79
105	JEEVA	30	Oligo	1	1	0	24	90	110	70	74
106	JEYAKALA	31	Oligo	1	1	0	24	92	120	80	77
107	DAISY	30	Oligo	1	1	0	23	93	110	70	79
108	PADMA	31	Oligo	1	1	0	24	95	110	70	80
109	VANITHA	34	Oligo	1	1	1	26	97	140	90	112
110	REGINA	33	Oligo	1	1	0	24	94	110	80	85
111	ANNIE	32	Oligo	1	1	0	24	94	110	70	88
112	ANANDHI	35	Oligo	1	1	0	24	95	110	60	82
113	MARIAMMAL	37	Oligo	0	1	1	23	91	120	80	119

114	KOWSALYA	39	Oligo	1	1	1	23	92	110	70	119
115	JEYANTHI	32	Oligo	1	1	0	23	90	120	80	70
116	PRABHAVATHY	33	Oligo	1	1	0	24	94	140	90	75
117	KAMATCHI	35	Oligo	1	1	0	24	92	140	90	79
118	VIJI	34	Oligo	1	1	0	23	94	140	90	84
119	SUCHITRA	31	Oligo	1	1	0	23	95	135	90	83
120	GNANAPRIYA	25	Oligo	1	1	0	22	92	120	80	87
121	KEERTHIGA	29	Oligo	1	1	0	24	95	110	70	89
122	GAYATHRI	31	Oligo	1	1	0	24	93	150	90	90
123	MALATHI	30	Oligo	1	1	0	24	92	110	70	79
124	PREMALAKSHMI	31	Oligo	1	0	0	19	87	100	60	74
125	RENUGA	33	Oligo	1	0	0	20	83	120	70	80
126	RAJI	31	Oligo	1	0	0	22	87	110	70	81
127	KAVITHA	32	Oligo	1	1	0	22	89	110	70	85
128	FARIDHA	33	Oligo	1	0	0	22	80	120	80	86
129	FATHIMA	34	Oligo	1	0	0	20	79	110	70	90
130	PRIYA	33	Oligo	1	0	0	20	77	120	80	80
131	SARASWATHY	34	Oligo	1	0	0	21	80	120	80	90
132	SHEEBA	31	Oligo	0	1	1	26	99	120	80	114
133	MENAKA	32	Oligo	1	0	0	23	86	120	80	85
134	TAMILSELVI	30	Oligo	1	1	0	23	88	120	60	88
135	SARALA	36	Oligo	1	1	0	24	89	140	90	82
136	DHATCHAYANI	35	Oligo	1	0	0	24	87	120	80	89
137	DEEPA	32	Ameno	1	0	0	22	83	120	80	80
138	DAISY	33	Oligo	1	1	0	23	89	140	90	79
139	KALI	36	Oligo	1	0	0	23	87	110	80	80
140	ILAVARASI	29	Oligo	1	0	0	23	86	120	80	85
141	MALINI	25	Oligo	1	1	0	23	88	100	60	87
142	JEYEPRABHA	24	Oligo	1	0	0	20	84	100	70	77

143	REVATHI	22	Oligo	1	0	0	20	85	100	60	76
144	ISHWARYA	27	Ameno	1	0	0	22	86	120	70	78
145	HARINI	27	Oligo	1	1	0	22	88	120	80	70
146	MANJULA	29	Oligo	1	1	0	23	89	140	90	74
147	PARVATHY	30	Oligo	1	0	0	23	90	110	70	80
148	VENI	31	Oligo	1	1	0	23	92	110	70	85
149	GANGADEVI	32	Oligo	1	1	0	23	90	100	70	83
150	ARTHI	33	Oligo	1	1	0	27	112	100	60	112
151	ASMA	34	Oligo	1	1	0	25	98	100	70	89
152	CHANDRA	35	Oligo	1	1	0	24	89	110	70	90
153	KEERTHIGA	37	Oligo	1	0	0	23	87	110	70	72
154	ARCHANA	36	Oligo	1	1	0	23	88	120	70	112
155	RATHA	33	Oligo	1	0	0	20	83	120	70	77
156	POOVITHA	32	Oligo	0	1	1	26	102	120	70	119
157	POORANI	31	Oligo	1	0	0	22	85	120	80	80
158	DEVAKI	30	Oligo	1	0	0	21	87	100	70	84
159	RANI	34	Oligo	1	1	0	23	90	110	70	88
160	ANNAMAL	35	Oligo	1	1	0	23	92	100	70	89
161	ARULARASI	34	Oligo	1	0	0	19	78	120	70	90
162	BANU	33	Oligo	1	1	0	21	90	110	80	76
163	NITHYA	32	Oligo	1	1	0	21	91	100	70	74
164	VANITHA	31	Oligo	1	1	0	22	94	100	80	79
165	ARUNA	29	Oligo	1	1	0	22	89	120	70	90
166	UMA	27	Oligo	1	0	0	22	87	110	70	85
167	NEERAJA	29	Oligo	1	0	0	21	86	110	80	83
168	KALA	27	Oligo	1	0	0	20	85	110	70	82
169	GEETHA	26	Oligo	1	0	0	19	79	120	70	89
170	SUBHA	24	Oligo	1	0	0	19	78	100	70	90
171	SANGEETHA	31	Oligo	1	0	0	20	80	110	70	74

172	MEENA	34	Oligo	1	0	0	20	82	110	70	78
173	THENMOZHI	26	Oligo	1	0	0	19	83	110	70	75
174	KARTHIGA	27	Oligo	1	0	0	18	76	110	70	80
175	KAVERI	23	Oligo	1	0	0	20	80	100	70	82
176	HAJEERA	25	Oligo	1	0	0	21	84	100	70	83
177	RAZIYA	30	Ameno	1	0	0	21	85	100	70	88
178	JANAKI	31	Oligo	1	0	0	21	82	100	70	90
179	JEYALAXMI	25	Oligo	1	0	0	21	84	120	70	89
180	RADHA	27	Oligo	1	0	0	19	78	110	70	88
181	NAVAJOTHI	29	Oligo	1	1	0	23	89	110	80	86
182	HALIMA	30	Oligo	1	0	0	20	80	110	70	84
183	USHADEVI	31	Oligo	1	1	0	23	88	100	80	81
184	AMALA	32	Oligo	1	0	0	21	84	120	70	82
185	SUSAN PAUL	33	Oligo	1	0	0	20	83	100	70	80
186	NANCU	28	Oligo	1	0	1	22	87	100	80	90
187	GANDHIMATHI	26	Oligo	1	0	0	23	86	110	80	80
188	ROSY	31	Ameno	1	0	0	22	86	110	80	85
189	NISHA	37	Oligo	1	0	0	19	79	100	70	88
190	REVATHY	33	Oligo	1	0	0	20	80	110	70	84
191	BARKATH NISHA	26	Oligo	1	1	0	23	88	120	70	81
192	JANANI	28	Oligo	1	0	0	22	85	120	70	83
193	VANMATHI	34	Oligo	1	0	1	23	86	100	70	90
194	MEENATCHI	37	Ameno	1	0	0	23	88	120	70	78

KEY FOR MASTER CHART

MC - Menstrual cycle

PCO (USG) - Polycystic Ovaries in Ultra Sonogram

BMI - Body mass index in Kg/m^2

SBP - Systolic Blood Pressure in mmHg

H - Hirsuitism

AN - Acanthosis Nigricans

DBP - Diastolic Blood Pressure in mmHg

FBS - Fasting Blood Sugar

TGL - Triglycerides in mg/dl

HDL - High Density Lipoprotein in mg/dl

WC - Waist circumference in cm

0ligo - Oligomenorrhoea

Ameno - Amenorrhoea

0 - Absent

1 - Present